CLAIMS

1. A counter current mixing reactor for continuously mixing two or more fluids of differing densities comprising a first inlet and an outlet characterised in that one or more further inlets are diametrically opposed to the first inlet and are disposed within the outlet.

2. A mixing reactor as defined in claim 1 comprising a first inlet and an outlet characterised in that a further inlet is diametrically opposed to the first inlet and is disposed within the outlet.

3. A mixing reactor as defined in claim 1 or claim 2 arranged in a vertical configuration.

4. A mixing reactor as defined in any of claims 1 to 3 wherein at least one of the fluids is in the sub, near critical or supercritical state.

5. A mixing reactor as defined in claim 4 wherein at least one of the fluids is heated, pressurised or supercritical water.

6. A mixing reactor as defined in claim 5 wherein the fluid of lower density e.g. supercritical water, is kept hot using a heater around the outlet.

7. A mixing reactor as defined in any of claims 1 to 6 wherein at least one of the fluids is a solution of a metal salt or compound.

8. A mixing reactor as defined in claim 7 wherein at least one of the fluids is an aqueous solution of a metal salt or compound.

9. A mixing reactor as defined in claim 8 wherein the aqueous solution is an aqueous metal salt solution of the metals selected from

transition metals including ruthenium, cadmium, rhodium, palladium, iron, cerium, titanium, zirconium, copper and silver.

10. A mixing reactor as defined in any of claims 1 to 9 wherein the fluid of higher density is cooler than the fluid of lower density.

11. A mixing reactor as defined in claim 10 wherein the fluid of higher density e.g. metal salt solution, is cooled using a heat sink.

12. A mixing reactor as defined in any of claims 1 to 11 wherein the one or more further inlets comprise a shaped nozzle, for example, a conical funnel.

13. A mixing chamber comprising one or more mixing reactors as defined in any of claims 1 to 12 arranged in series.

14. A process for preparing metal or metal oxide nanoparticles which comprises delivery of a metal salt solution through a first inlet of a mixing reactor as defined in any of claims 1 to 12 and delivery of a fluid in the sub, near critical or supercritical state through a further inlet diametrically opposed to the first inlet wherein said further inlet is disposed within an outlet such that the mixed solutions exit the reactor once mixed.

15. A process for preparing metal or metal oxide nanoparticles which comprises mixing a solution of supercritical water with an aqueous metal (e.g. transition metal) salt solution, characterised in that the aqueous metal salt solution is cooled prior to mixing.

16. Metal or metal oxide nanoparticles obtainable by a process as defined in claim 14 or claim 15.

17. A device capable of mixing two fluids of differing densities in which the lees dense fluid is introduced into the device in a downwards orientation relative to a upwards flow of denser fluid.

18. A device as specified in claim 17, characterised by the inlet of the less dense fluid having a conical nozzle to aid mixing of the fluids.

19. A device as specified in claim 17 or claim 18 in which the denser of the two solutions is cooled prior to entry into the reactor.

20. A device in which two or more devices specified in any of claims 17 to 19 are used in series.

21. A method of mixing two fluids of differing densities in the devices specified in any of claims 17 to 20 such that the mixing is both efficient and localised within the device.

22. A method as claimed in claim 21 in which one or both fluids is/are in the near critical or supercritical state.

23. A method as claimed in claim 21 or claim 22, in which one of the fluids is near-critical or supercritical water.

24. A method as claimed in any of claims 21 to 23, in which one of the fluids is an aqueous salt solution.

25. A method as claimed in any of claims 21 to 24, in which the device of claims 17 to 20 is used in the synthesis of metal nanoparticles.

26. A method as claimed in claim 25 in which the device of claims 17 to 20 is used to produce nano-particulate cerium oxide.

27. A method as claimed in claim 25 in which the device of claims 17 to 20 is used to produce nano-particulate titanium oxide.

28. A method as claimed in claim 25 in which the device of claims 17 to 20 is used to produce nano-particulate zirconium oxide.

29. A method as claimed in claim 25 in which the device of claims 17 to 20 is used to produce nano-particulate copper oxide.

30. A method as claimed in claim 25 in which the device of claims 17–to 20 is used to produce nano-particulate silver oxide.

31. A method as claimed in claim 25 in which the device of claims 17 to 20 is used to produce mixed metal oxides, specifically mixed copper and zinc oxides.